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Grade 11G

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This report has been updated on the 18th of December 2018 to include a disclaimer and foreword.

Background

The following report was completed for the International Baccalaureate Middle Years Programme (IB MYP) Digital Design (Grade 11) at Fairview International School Subang, Malaysia on 29th March 2017.

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Criterion A - 1.0 Inquiring and Analysing

Section	Remarks	Date
1.0	Introduction	10/12/2016
1.1	Problem Description & Design Situation	12/12/2016
1.2	Task related to Real Situation	14/12/2016
1.3	Research Plan	23/12/2016
1.4	Research and Answers	30/12/2016
1.5	Case studies, Existing Products	9/1/2017
1.6	Design Brief	12/1/2017
1.7	Research Findings	13/1/2017

CRITERION A

1.0 Introduction

Ergonomics is defined as the study of people's efficiency and the relationship their living environment around them. Environment is defined as the surroundings or conditions in which a person, animal, or plant lives or operates. The ergonomics of a product will impact the end user's interaction with the product and the way the product affects them. It will determine if the product gives them benefits or disadvantages, whether it is useful or harmful and whether it is easy to use or difficult to operate. Factors that affect ergonomics are the age group(s) of end users, location and general environment of end users as well as current satisfaction of end users and more statistics like the economy of the area as well. Measurements, also known as anthropometric data, are collected and applied to designs of products, to make them more comfortable for a group of end users to use. Anthropometric data is used to determine the size, shape and form of a product, making it more comfortable for the target end users to use. The application of measurements to products, in order to improve their human use, is called Ergonomic design. Ergonomic design usually starts off with studying people and how they interact with products and their environment. Data of the target end users comfort levels of the existing product, or their individual relevant measurements and data will need to be recorded for this. Ergonomic design opposes the statement "one size fits all". "One size fits all" is not a true statement as that would mean a shirt of one, standard size would fit everyone, or even a small, bottle cap sized packet of candy would be sufficient for a large adult to consume.

1.1 Problem Description

i) Problem

One major ergonomic issue these days are sizes and shape of mobile phones. Ever since the development of mobile phones, they have become smaller and smaller, from large brick sized phones to phones smaller than hands, and had more functions packed into them. Initially, smartphone pioneer manufactures like Apple believed that "one size fits all", and it should be right that phones become smaller. However, as users began to complain about how small and illegible the text displayed on their screens were, and also complained about how heavy their phones were and the working class complained about how thick and bulky their phones were,

Apple decided it was time for changes, after they saw major mobile phone manufacturer Samsung increase the size of their phones from 3.5 inches to 5.5 inches. (Refer to Appendix 1) Apple went large in terms of size and started to make larger phones again, at the same time creating thinner and lighter phones. They are a good case study of a company who develops their ergonomics well via good anthropometric data collection and many other phone manufacturers soon followed. Phone manufacturers have long only looked at phone battery life. Power banks were also a product created due to ergonomic improvement. Using anthropometric data collection, the team that invented the first power bank decided that having a battery with too much power inside constantly running alongside many other various heat-generating internal components was a safety hazard. (Refer to Appendix 2) Therefore, the team decided that engineering a device that could pack extra power outside of the phone was ergonomically the best. Operating Systems are also designed ergonomically, for example Apple's iOS uses user collected suggestions for the update designs. On the product design side, however, companies are focusing more and more on looks and not concerned or considering how phone usage affects people's physical state of health. Dr. Kenneth K. Hansraj, Chief of Spine Surgery at New York Spine Surgery and Rehabilitation Medicine did a study and the results showed that despite the optimum amount of weight the spine should take should be 10 to 12 pounds for a healthy spine, when people use their phones.

ii) Target Audience

There appears to be a need for individuals around the world aged 13 and above (as not many children 12 and below handle digital products on their own) for my product as most people start using portable technology in their lives at that age these days. My product will decrease the neck strain and risks of back injuries for end users. According to Google Surveys, today's younger generation aged 30 and below rely mostly on the convenience of technology to perform their daily routines. From typing on tablets to do their work and homework to watching television on it, holding their phones all day long playing games or taking photos and carrying their phones with them to use as a music player, the younger generation relies on phones and tablets for pretty much everything.

1.2 Task related to Real Situation

Technology as a solution

Since the internet (especially social media platforms) are popular these days and many age ranges access them, it is a good idea to use the internet to spread awareness about how the designs of portable digital devices are actually not really good and cause people trouble while using the devices.

1.3 Research Plan

No	Topic	Duration	Resources	Guiding Question	Why is it important?
1	Phone & Tablet Computer Ergonomics	2 hours	Primary and Secondary	What are phone ergonomics about?	It is important to have knowledge and understanding what can affect how ergonomically designed the phone is.

2	Mobile Phone Usage Risks	2 hours	Secondary	<p>What are the potential risks that come with constantly using your mobile phone for a long time and/or for your daily tasks?</p> <p>Can these injuries or risks be prevented by the end user?</p> <p>How can we improve the product design to decrease risk or injury to the end user? Are there existing solutions?</p>	I want to point out the fact that the risks and injuries that come with long term mobile phone usage for daily activities is due to flaws in the product design.
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1.4 Research Answers

1) Mobile Phone Ergonomics

i) What are phone ergonomics about?

Phone ergonomics would include the software that is installed in the device and how well users are able to use and interact with the software, whether the hardware is sufficient to power the device or makes it faster, whether the external product design is designed in such a way where it suits the hardware so the heat from the hardware will not get to the end user that fast and make the end user uncomfortable. It should also include whether there are any physical and/or mental health effects if the end user constantly uses the device.

2) Mobile Phone Usage Risks

i) What are the potential risks that come with constantly using your mobile phone for a long time and/or for your daily tasks?

Due to end users tilting their heads downwards to look at their phones, the users will bend their necks at an undesirable angle of 45 degrees which exerts around 49 pounds of weight on the spinal cord, where the maximum amount of weight that should be exerted on the spinal cord for a healthy spinal cord is only 10 to 12 pounds. According to Dr. Kenneth K. Hansraj, Chief of Spine Surgery at New York Spine Surgery and Rehabilitation Medicine, people spend an average of two hours on their phones daily and this results in over 1400 hours of unnecessary strain on their spines annually and could lead to injuries like a broken spinal cord or back injuries. The end user may also experience permanently deteriorated eyesight after long periods of usage of their mobile phone because of the gamma rays being emitted from the screen and the large amount of unnatural blue light generated by the screen. If the end user lies down and looks at their mobile phone screen, their eyes could get even more damaged due to the unnatural eye muscle position. Finally, the end user may experience muscle sprains in their elbows, wrists and shoulders as well after holding and using their mobile phone or tablet computer for a long time. When using larger mobile phones, end users tend to bend their necks at an even more undesirable angle of 60 degrees with around 64 pounds of weight on the spinal cord, hence increasing the risk of back injuries even more.

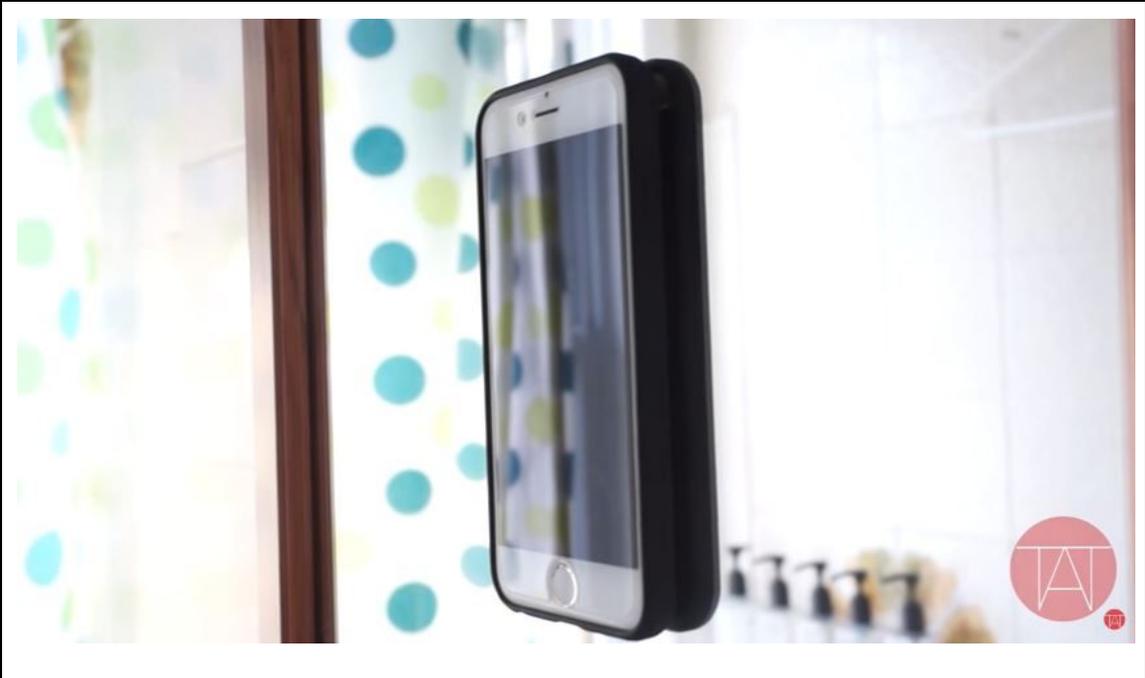
ii) Can these injuries or risks be prevented by the end user?

The end user could prevent tilting their head downwards by looking at their mobile phone and/or tablet computer at their eye-level. However, this will cause further strain on their elbows, wrists and shoulders because their hands have to be lifted up higher, causing there to be a greater gravitational force to be exerted. The end user may wear glasses with blue light filters to diminish the effect of gamma rays and blue light on them. The end user however, cannot on their own diminish muscle sprains. Without any other separate attachable product, the end user is not able to let their phone stand on its own.

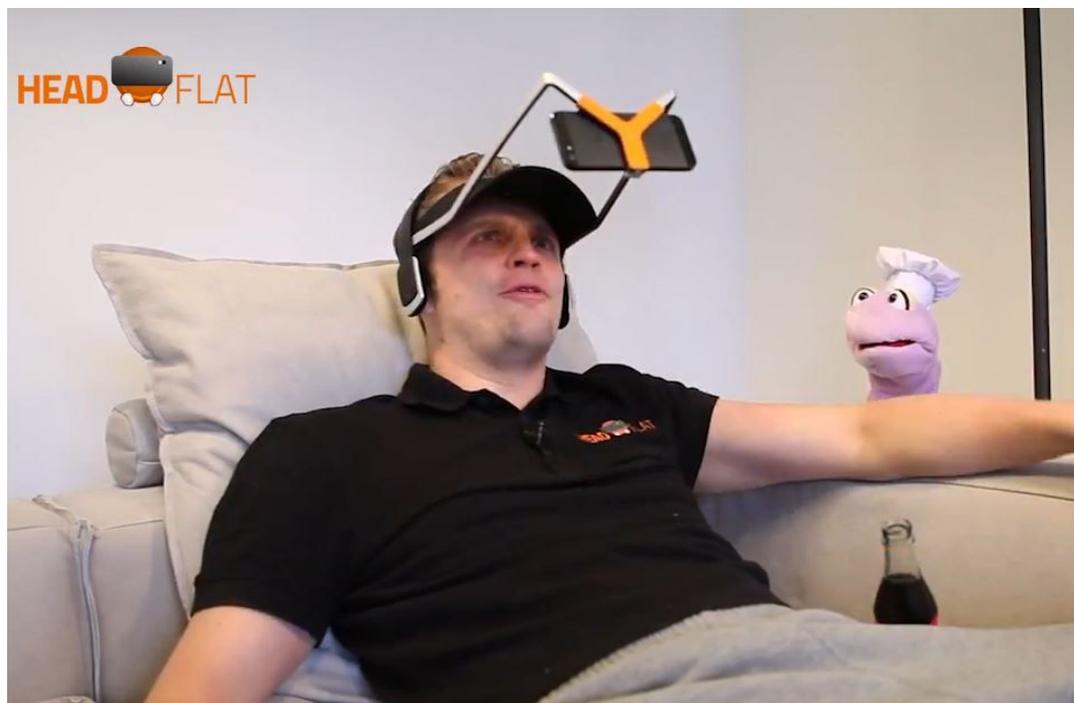
iii) How can we improve the product design to decrease risk or injury to the end user? Are there existing solutions?

The existing product design needs to be made in a way where the user is able to hold the phone yet also make it stand if their hands are tired. An existing product for this is called a flip phone cover or phone tripod stand. However, most flip phone covers still cause users to have to bend their necks at undesirable angles. Therefore, the goal would be to create a phone stand that would let the user have their head at eye level or just slightly below eye level, and also let them carry their phone around. The product should not be expensive like some of the other existing solutions out there. The end user's risk of deterioration of eyesight can be prevented with the end user wearing blue light filter glasses, but most phones already do come with a built-in blue light filter setting as well. To reduce hand muscle strain, end users usually lie down to use their phones but little do they know that lying down and looking at their phone screen is causing their eyes internal damage due to the unnatural position of the eye muscles and the amount of gravitational force being exerted on them. More existing solutions such as anti-gravity cases, hat phone holders and ring phone holders enable users to freely use their device without holding them. However, these solutions all have multiple cons, some of which are totally undesirable for the sake of users' health and safety.

1.5 Case Study

Case Study 1 - Anti-Gravity Phone Case	
	
Summary	This anti-gravity phone case works by letting the user put their phone in a case and stick it onto any flat surface, enabling them to use their phone without straining their arms, eyes or their neck.
Structure	The product is designed with nano suction cups behind it and it sticks to all flat surfaces both vertically and horizontally.
Target audience	The target audience for this product are any smartphone users.
Pros and Cons	The product can only be stuck onto a flat surface, and would be hard and inconvenient to use in public, where people use their phones the second most after their own bedrooms. Consumers who used this product say that after a short time of usage caused their phones to fall down and break. (Refer to Appendix 3) Consumer reviews on Amazon and product reviews from USA Today also say that this product comes at a high price and is not likely worth their money for their health.

Case Study 2 - Hat Phone Holder



Summary	This hat phone holder is designed to let the phone user use their phone hands free and worry free without dropping it. They will not strain their arms either.
Structure	The product is basically a selfie stick modified to be attached to a wearable cap that holds the phone facing the user's face.
Target audience	The target audience for this product are any smartphone users.
Pros and Cons	The product can still cause neck strain and eye strain because the user may use it lying down or bending down. Furthermore, since the product is hands free, this may encourage the user to do so. Consumers who have used this product say that they use it mostly lying down, which actually further damages the eyes. However, this product is relatively cheap, and can be seen on Amazon going for as low as US\$5.

Case Study 3 - iRing Phone Stand



Summary	This product enables users to use their phones free standing.
Structure	The product is basically a ring attached with adhesive to a phone and it can hung on any surface and can also be used as a stand.
Target audience	The target audience for this product are any smartphone users.
Pros and Cons	The product can still have issues like the ring coming off the phone or the product may even cause users to further strain their necks due to the unusual of the product stand. Consumers who have used this product have reported neck muscle sprains after looking at their screens for a long time and reported the ring's adhesive falling off, causing their phone to break when hanging the phone. Consumers say this product is quite highly priced.

1.6 Design Brief

From my research, I have found that... therefore I want ...To design and digitally present an ergonomic and economically friendly product to decrease the risks of the usage of mobile phones (such as muscle sprains, neck sprains, spinal cord injuries and eyesight deterioration) to perform our daily tasks in our lives in a long-term for a long time. To also create a brochure to point out how their current design is non-ergonomic and what risks do they impose. There needs to be a short introduction of ergonomics of mobile phones and tablet computers from Research Question 1, followed by a brief section of the discussing about some case studies. Also will include statistics and surveys about how real end users feel towards the fact that their mobile phones are able to cause them injuries and whether they feel like they are being injured by their phones and tablets or not. Will also use the brochure to promote the product and its benefits.

- The product will decrease or possibly eliminate the risks that come with using mobile phones daily for a long period of time.
- The target audience individuals around the world aged 13 and above as most people start using portable technology in their lives at that age these days. Today's younger generation aged 30 because they use technology in their lives the most according to UN surveys and they need to be aware of the risks of using badly designed technology.
- I will create the product model and I will create a brochure for awareness of why we need improvement in phones and the product.

1.7 Research Findings

i) Primary Sources

From my primary sources, basically my own experiences, I have found that indeed there is a lot of neck strain and back pains when using mobile phones without any assistive equipment.

ii) Secondary Sources

From my secondary sources, I have found out that many end users say despite the fact that they've purchased devices to enable their phones to be used much more easily, the devices only would bring more damage to their phones.

Criterion B - 2.0 Developing Ideas

No.	Task	Date of completion
2.1	Design specification	26/1/2017
2.2	Designs	3/2/2017
2.3	Evaluation against design specification	4/2/2017
2.4	Chosen design and justification	4/2/2017
2.5	Improvement	5/2/2017
2.6	Summarized Overall Goal	5/2/2017
2.7	Final Chosen Design	5/2/2016

Note: Refer to Appendix 6 for Product Rubrics

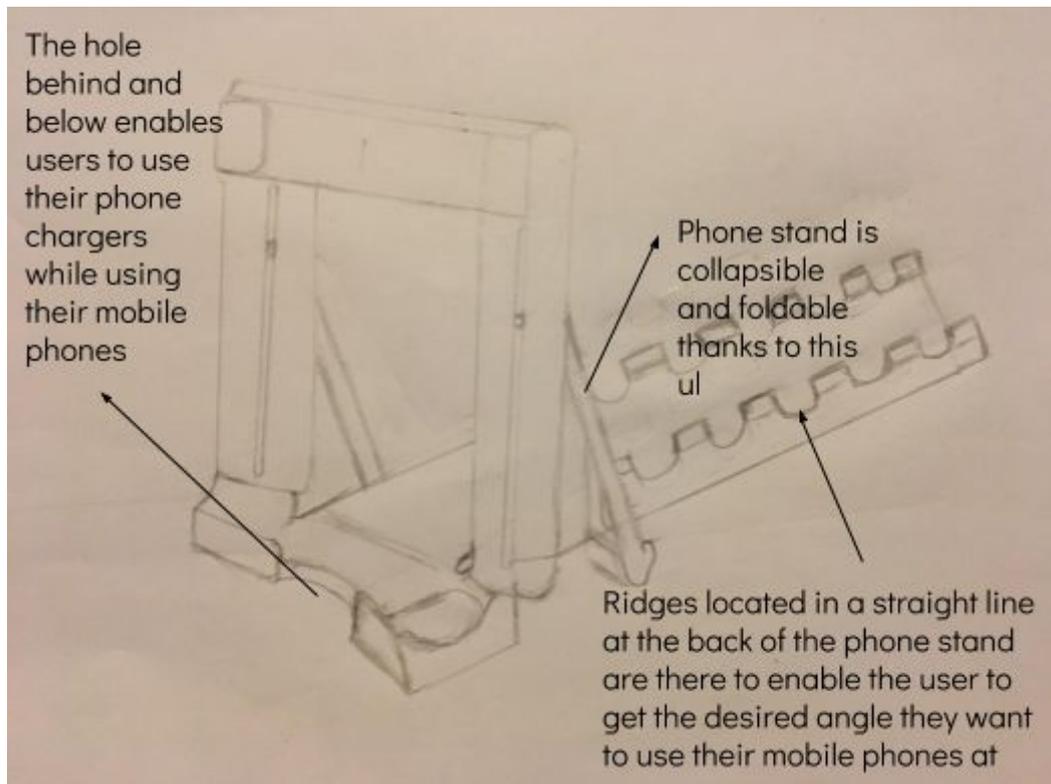
CRITERION B**2.1 Design Specification**

No.	Description	Why is it important?	Priority
1	Low Cost (Less than US\$25)	It is important that end users do not spend as much money as they do when purchasing the existing solutions that they complain are expensive.	11
2	Child Friendly	It is important because children actually use phones a lot and if they use the phones from young without any equipment to prevent back injury and neck strain, this could lead to further severe issues when they grow up.	7
3	Senior Friendly	These days, senior citizens are becoming more and more technologically savvy and they have adapted to using mobile phones in their daily lives. However, due to their bones being weak, fragile and brittle, without using any devices to assist them to use their mobile phones, they could be severely injured in the neck or in the back.	8
4	Doesn't Affect Phone Function Usage	It is important that the product doesn't stop the phone from performing what it is supposed to do. The product cannot block out any necessary radio waves (Wi-Fi, Bluetooth, NFC, Mobile Network) for the phone to function.	4
5	Compact (Maximum 15cm height, 15cm length and 15 cm width)	This is not a very important specification but if possible, it should be compact to prevent the need for users to chug around a large stick or pole attached device with them all day long.	9
6	Doesn't Damage Phone or Void	The device should not damage the phone or potential damage like the existing solutions	3

	its Warranty	that users complain about. It also shouldn't void the phone's warranty.	
7	Doesn't Cause User Other Types of Harm	The phone stand should not malfunction and hurt the user such as in the second product case study where there is a possibility of the phone dropping from the stand and hitting the user in their face or any other various body parts.	1
8	Modular	It has to be easy to affix to phone, easy to install and will not be hard to assemble. If it comes ready made, the user may attempt to manipulate it and adjust in it ways that it shouldn't be and end up breaking it. If it is modular, the user can detach parts that they don't need or add parts that they need at any time they want to.	10
9	Adjustable Height to Fit Different Users	The height of the phone needs to be able to be adjusted to fit different users as different individuals have different heights. Therefore, they will only achieve minimal risk of back injury or neck and/or eye strain when their phones are positions at different heights.	2
10	User-friendly	It cannot be too hard for the user to use (e.g. to to point where the user does not know how to set it up)	12
11	Digital product presentation must be a realistic scaled 3D model	This is important as the presentation of the product model can impact users opinions on the product as well as their thoughts on whether they would use the product or not. The model should have realistic shadows and lighting as well to gain better audience reaction.	5
12	Product should be annotated	As the product is presented digitally, the product should be annotated as audience cannot hold the product so they won't know the functions without annotations.	6

2.2 Design

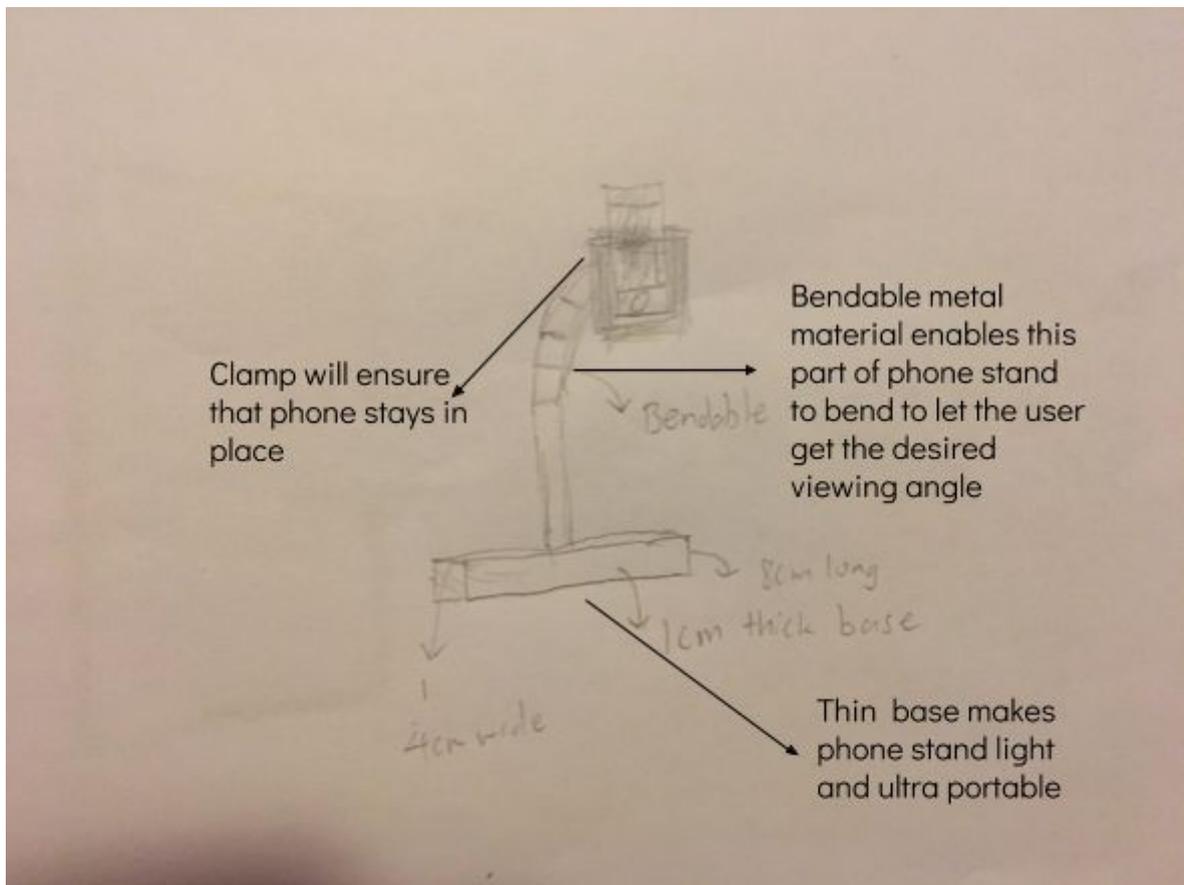
DESIGN 1:



2 variations of a phone stand that has an adjustable angle.

- Phone stand will include an area to place the phone
- There have to be two variations of the phone stand in order to fit users phone sizes, due to the fact that the user may want to use accessories such as earphones while using their device and the phone's ports may be in different positions.
- The phone stand can also be folded flat and therefore can be packed into anywhere.

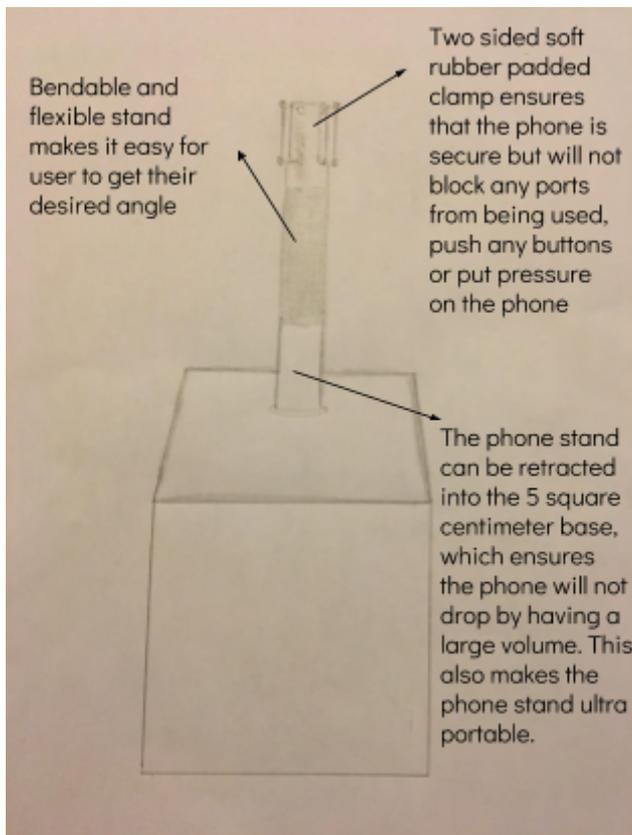
Advantages	Disadvantages
<ul style="list-style-type: none"> • If the user wants to carry this around, the phone stand can be packed anywhere and can also be used anywhere. • This will be cheap and easy to manufacture and will be cost friendly for the user. 	<ul style="list-style-type: none"> • Does not help the user fully overcome the eye strain or neck strain issue as only the angle of the phone stand is adjustable. The height still depends on the surface it's placed on. • The phone isn't securely secured.

DESIGN 2:

Phone stand with adjustable and modular stand and the modular stand can be adjusted to the users height.

- The phone stand is adjustable via the modular stand that is bendable. The angle also can be adjusted that way.
- The modular stand is attached to a base that is sufficient enough to support the phone.
- The base shall not be more thick than 2 cm.

Advantages	Disadvantages
<ul style="list-style-type: none"> • This will secure the user's phone properly and ensure that it doesn't drop. • Supports all phone sizes • Helps the user with neck, arms and eye strain prevention and as well as back injury prevention. 	<ul style="list-style-type: none"> • Takes a long time to set up and get the right angle. • It can't be stored in a bag, or else it could break. • It still has height limitations that depend on the surface height. • It could potentially make the phone drop because the phone would likely be heavier than the stand itself

DESIGN 3:

Phone stand with bendable modular stand attached to base and the phone clamp.

- The phone stand is adjustable via the modular stand that is bendable. The angle also can be adjusted that way.
- The modular stand is retractable at the push of a button into the cubic base that will not be bigger than the size of a standard rubik's cube at 5 square centimetres.
- The base has another attachment at the bottom that can be expanded to increase the height of the device.

Advantages	Disadvantages
<ul style="list-style-type: none"> • This will secure the user's phone properly and ensure that it doesn't drop. • Supports all phone sizes • Helps the user with neck, arms and eye strain prevention and as well as back injury prevention. • It can be easily retracted and transported around in a bag. • Height limitations can be conquered by the expandable base. 	<ul style="list-style-type: none"> • Takes quite a long time to set up and get the right angle. • Fairly costly to produce and sell

2.3 Designs Evaluated against the Design Specification with Rubrics

Specifications		Design 1	Design 2	Design 3
Aesthetics	Is it modular?	X	✓	✓
	Is it portable	✓	X	✓
	Does it qualify to be a brochure?	✓	✓	✓
Cost	Can the product be completed with as less cost as possible?	✓	✓	X
	Can the product be sold at a reasonable cost?	✓	✓	X
	Can the product be completed quickly?	✓	X	X
Target audience	Is the product suitable for the target audience?	✓	✓	✓
Environmental considerations	Does it bring any negative effects to the users environment?	✓	✓	X
Function	Does it affect the user's phone functions?	✓	X	X
	Will it satisfy the intended function?	X	X	✓
Success criteria	What grade will it be given, according to the rubrics?	4	6	7

2.4 Final Design with Justification

My final design would be Design 3 because it ticks the important points on the Design Evaluation and follows all the Design Specification. The cost will definitely be less than US\$25, and it is only the fifth priority. The time taken to make the product isn't really taken into consideration as well, because the aim is to simply provide users with an ergonomic solution for a product, and the aim is not to churn the product out as quickly as possible. It also doesn't affect the user's phone function or experiences, it satisfies the intended function, and it's modular and portable as well. It is also able to perform all the initial intended functions. It will reduce the user's arm muscle strain by letting the user use it hands free. It will reduce eye, neck and back strain because it can enable the phone to be used and adjusted to the user's preference and/or height.

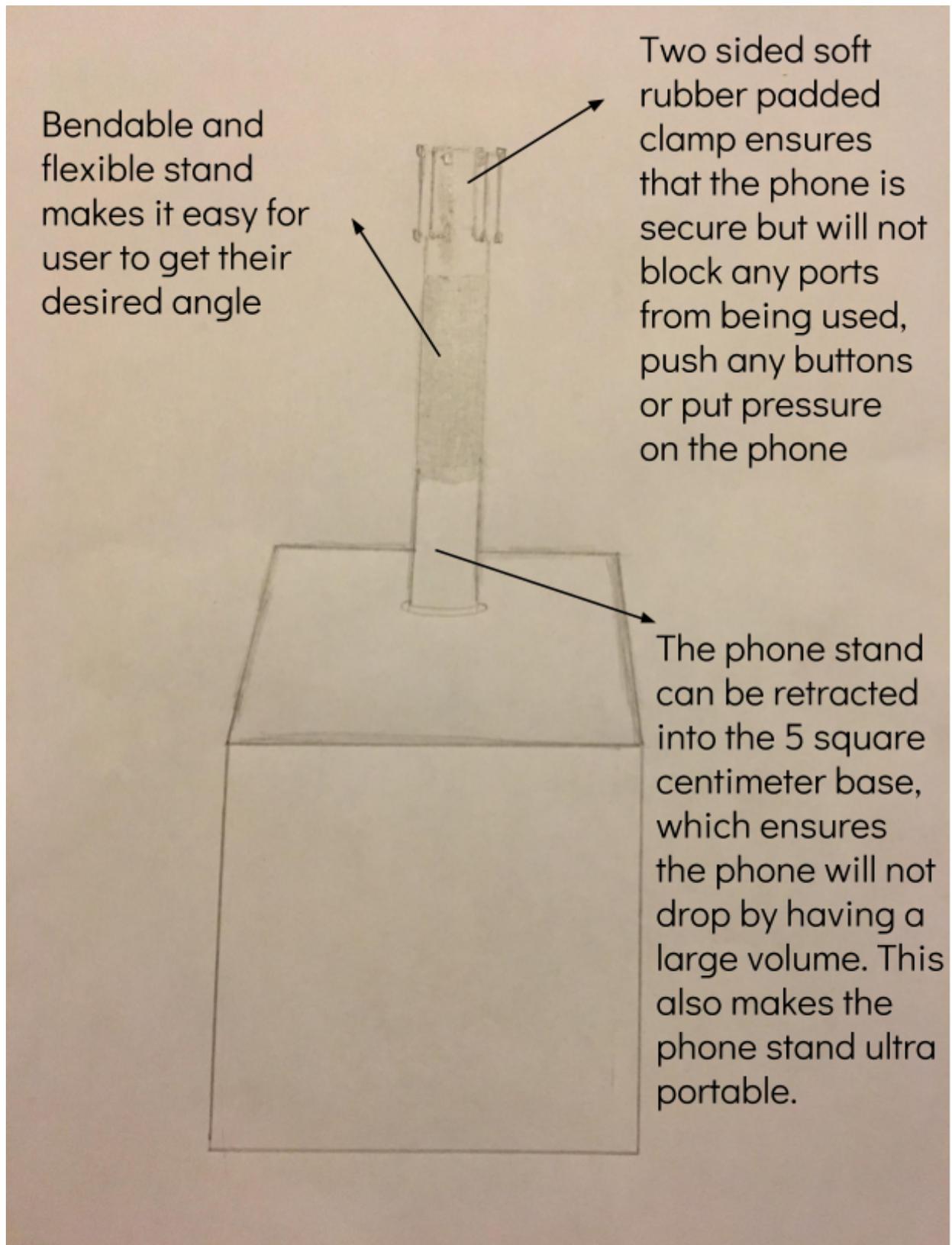
2.5 Improvements

I think that Design 3 isn't good enough because it takes time and more money to make the product. However, one cannot cut costs by using cheaper materials or missing out some parts. Instead, the cost can be reduced by using effective manufacturing, such as having only one person assemble all of the products in one section, instead of delegating each person to assemble the entire thing, and one person inspect it in the end.

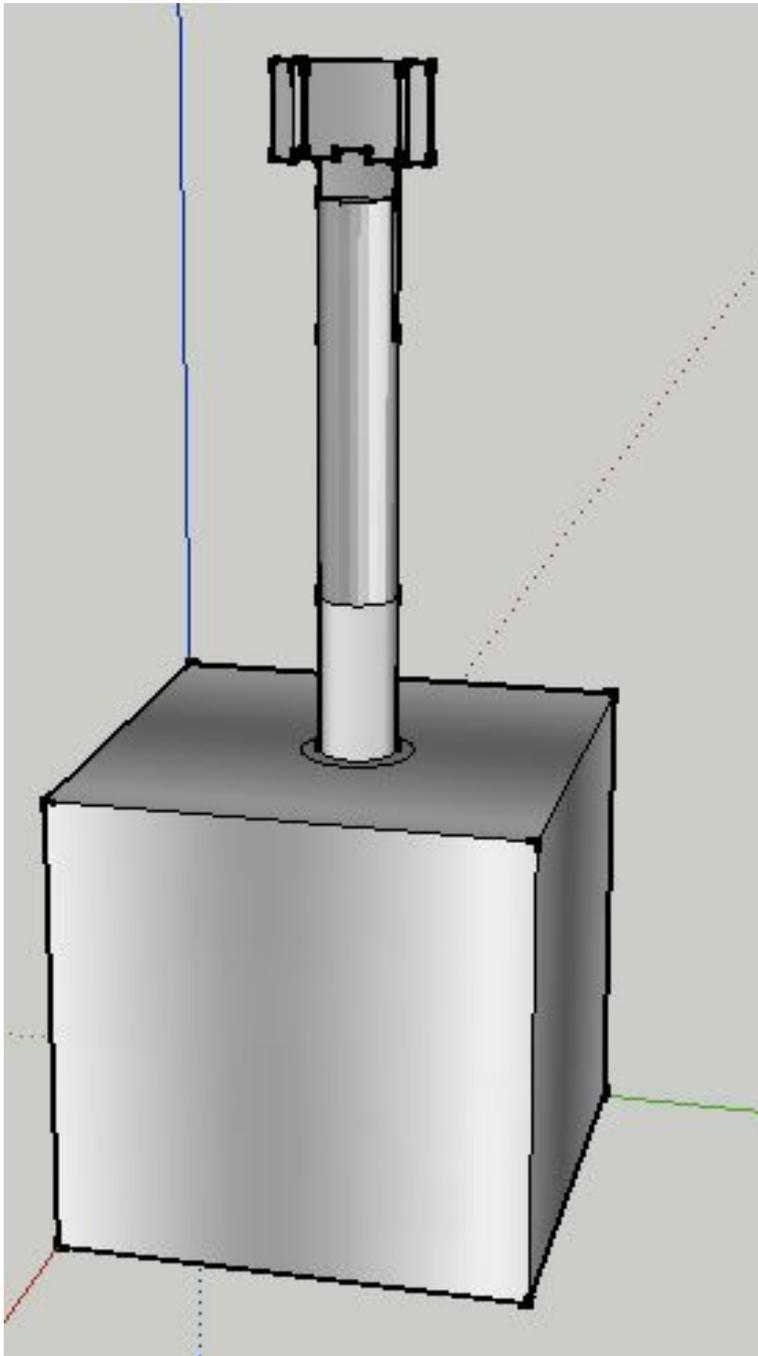
2.6 Summarized Overall Goal

- To prevent the risk of back injuries and neck injuries for users while they are using their mobile phones.
- To assist users to have relaxed muscles when they are using their mobile phones.
- To prevent users eyesight from deteriorating too much from using their mobile phones too much.

2.7 Chosen Design



Rough Untextured Digital Sketch of Product in Google Sketchup



Criterion C - 3.0 Creating the Solution

No.	Task	Date of completion
3.1	Developing the Plan	8/2/17
3.2	Creating the Product	16/2/17
3.3	Design Changes with Justification	17/2/17
3.4	Evaluation of Plan	19/2/17
3.5	Final Product	19/2/17

CRITERION C**3.1 Developing the Plan****Step-by-step plan procedure**

Step	Task	Required Resources	Materials	Time to complete
1	Try Out Softwares Before starting to create my product, I will first have to look for 3D digital modelling programs that are easy to use and time efficient, as well as ensuring that they can be used with my computers.	Software Selections	Laptop Google Search Software Reviews	2 days
2	Choose Software After I have tried and evaluated the softwares, I will have to pick the best software out of all of them that I have selected.	Google Sketchup	Laptop Google Search Online Product Reviews	2 days
3	Start Digital Sketch I would need to do a rough sketch in the program I chose and I will start with 2D sketching first.	Google Sketchup	Laptop	2 days

4	<p>Add Textures</p> <p>I will add textures to the 3D sketched model based on my product descriptions and my product specifications.</p>	Google Sketchup	<p>Paper</p> <p>Pencil</p> <p>Scanner</p>	1 day
5	<p>Render Textures</p> <p>I will render out the textures of the product.</p>	Google Sketchup	<p>Paper</p> <p>Pencil</p> <p>Scanner</p>	1 day
6	<p>Fix any issues</p> <p>I will fix any issues with the digital model (such as scaling issues, lines overlapping and incorrect positioning of shapes).</p>	Google Sketchup	Computer	1 day
7	<p>Render 3D model</p> <p>I will use 3D rendering software to render out the 3D Model together with textures.</p>	Adobe Photoshop	<p>Computer</p> <p>Google Sketchup</p>	3 days
8	<p>Add Shadows and Lighting</p> <p>I will add the shadows and lighting to the 3D rendering.</p>	Adobe Photoshop	<p>Computer</p> <p>Google Sketchup</p>	3 days
9	<p>Refining</p> <p>I will put the design into Google Cardboard Virtual Reality Software to test it and refine it.</p>	Presentation	<p>Computer</p> <p>Google Sketchup</p> <p>Google Cardboard</p>	1 day

Gantt Chart

Things to do	January					February					March			
	2 6	2 7	2 8	2 9	3 0	10- 14	24- 25	26	27	28	5-11	12-16	17	18
Research														
View Existing Solutions as Case Studies														
Evaluate Case Studies														
Sketch Product Designs and Installations														
Choosing the Final Design with Justification														
Drawing Product Digitally														
Drawing Installation Digitally														
Refining														
Final Check														
Self-evaluation														
Peer-evaluation														
End-users evaluation														
Evaluation against Design Specification														
Submission														

3.2 Creating the Product

Step 1: Try Out Softwares

I started out my creation of my product by trying out various softwares and sampling them by constructing a simple cube. I downloaded AutoCAD, Adobe Illustrator, and Google SketchUp to test. For each software, I constructed the same sized, untextured cube and my first finding was that Adobe Illustrator was meant to construct 2D Vector based images only. Therefore, I had to eliminate it. I also looked for a good 3D rendering software, and Adobe Photoshop was the only high quality and reputable textured 3D rendering software I could find. When I tested out other rendering softwares, they didn't render out the textures and hence my cube looked only like a white and gray mass.

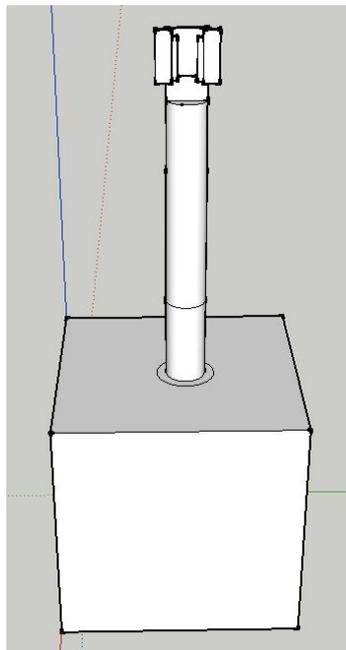
Step 2: Choose Software

I decided that I would use Google's Sketchup, a free to use (for non-commercial purposes) software that enabled me to illustrate three dimensional diagrams realistically and smoothly. I had initial ideas of using other three dimensional illustration softwares such as AutoCAD. I also thought of using Adobe Illustrator or Photoshop. Adobe Illustrator or Photoshop would cost me a fairly huge amount of time due to me having little experience with them and therefore needing to learn the skills to work and it would take many "layers" of digital drawing to create a three dimensional product that didn't look like a vector generated image. Therefore, I also wanted to save the time cost, so I proceeded with Google Sketchup, a program that I'm familiar with already and one that can instantly give me three dimensional renderings of any item that I wish to build. I first started drawing the product, followed by the installation. I used a separate software, Apple's Keynote Presenter to create the installation labelling because the text had to be two dimensional, or else the product installation description would be rather hard to read. For the 3D rendering, I had no other options but to use Adobe Photoshop because other options on the market did not let me render 3D objects with textures.



Step 3: Start Digital Sketch

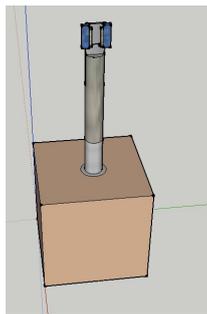
I started my digital sketch by drawing the base for the phone stand. The base of the phone stand was a cubic shaped box. Following that, I illustrated the stand itself that was connected to the base. The stand was a cylindrical shaped pole that was attached directly to the base. The pole is designed to be retractable into the cube. Following that, I added the bendable metal pole that would be “welded” into the cylindrical shaped pole. The bendable metal pole has a mechanism where it can be straightened compressed to retract into the cube. Next, I added the clamp on the top to the phone stand. The clamp would not be retractable. I made sure that my phone stand and clamp were carefully “secured” to each other in the 3D Sketch. I ensured that there were no errors in my diagram, for example like the wrong fittings, wrong scalings or gaps in between parts and sections. I will ensure that it is constructed well and properly. The sketch was then rendered in a way that textures could be added to it and they would look fairly interesting and realistic as well.



Step 4: Add Textures

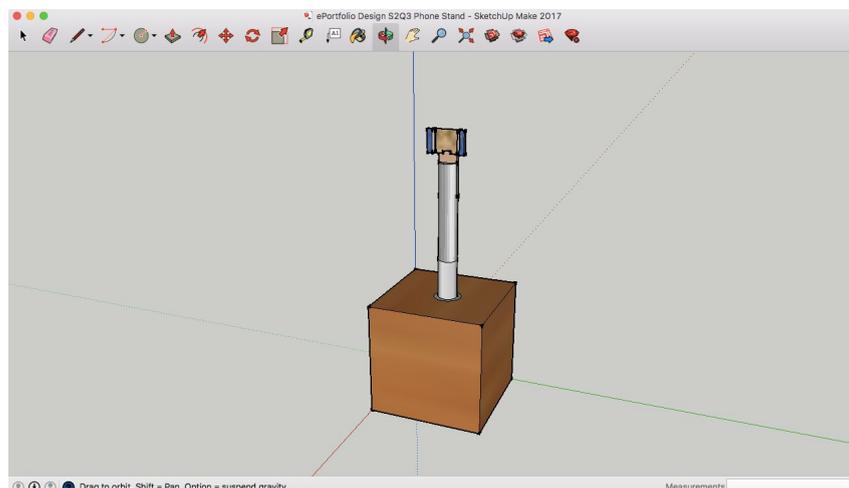
I added the textures to my model by using the Google Sketchup textures tool. I choose my textures carefully and made my decisions there and then because in my design specifications, the materials specified were generic, e.g. lightweight materials and strong materials.

Therefore, I decided to make the base out of wood and plastic, as it would be able to be hollow, strong yet lightweight. The stand of course would be made of metal and same is said for the pole. The clamp however, needed to be made of plastic and with rubber paddings at the side as specified, to prevent the user's mobile phone from getting scratched or having too much pressure put on it.



Step 5: Render Textures

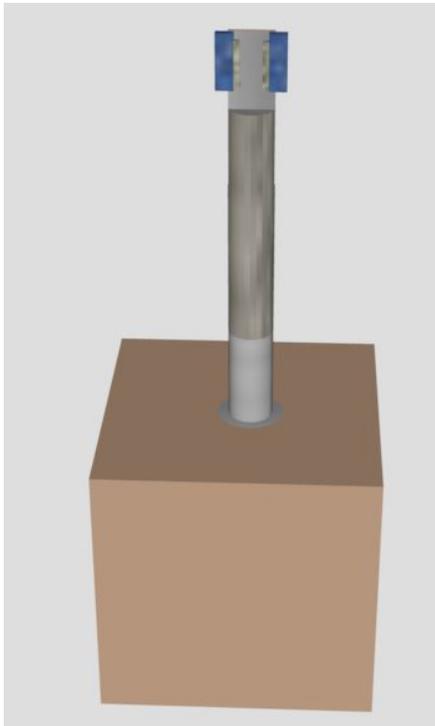
I rendered the textures in my model to make them look more realistic than before. I did this by using Google Sketchup's built-in rendering tool. However, this does not mean that the 3D model would look like that because the textures files would only be considered in when the lighting and shadows were added.



Step 6: Fix any issues

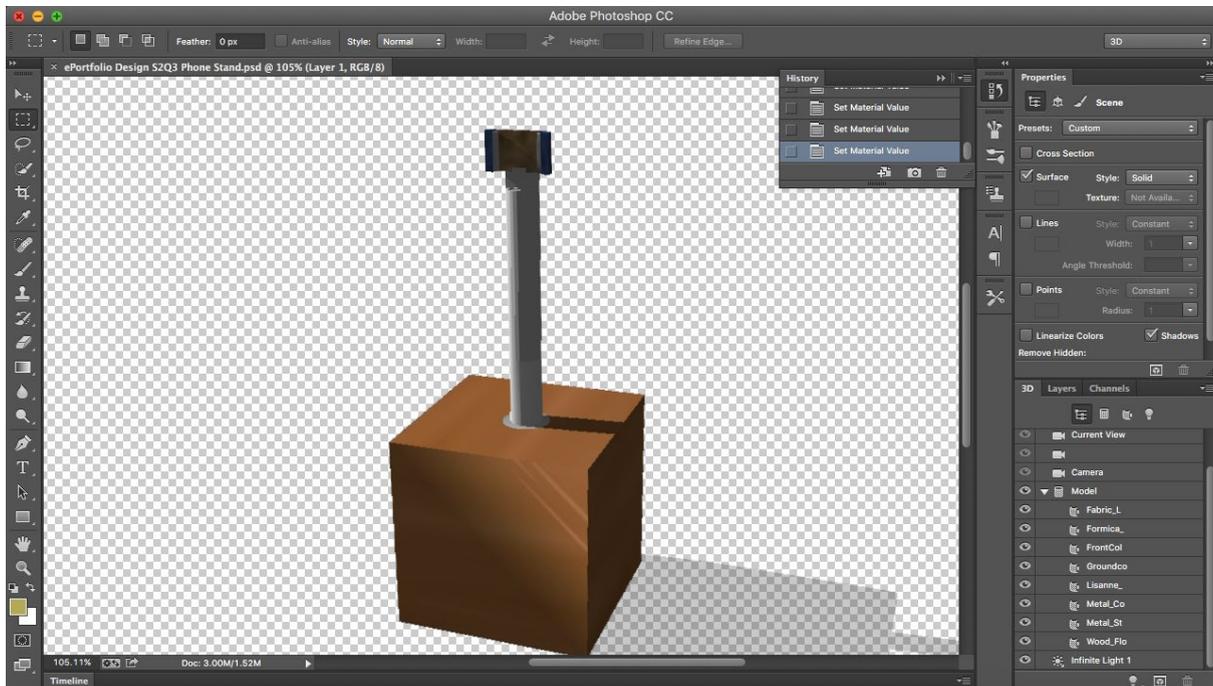
For this step, I ensured that there were no issues in my 2D model so that I could export it as a 3D render. The issues I picked up and fixed were issues like positioning and texture lighting issues. I also picked up issues like textures not being smooth or perfect due to the construction of the 3D model and certain overlapping parts that could not conform to the laws of physics. I fixed them before rendering it as a 3D model.

Step 7: Render 3D model



The 3D render could not have the complex textures in it due to Adobe Photoshop's limitations, that do not enable you to show the textures until you add the shadows and lighting into your model. There was no solution to this. At this stage, I also constructed a separate installation diagram with annotations on pen and paper, but in the end I removed the diagram from my product part and moved it to my appendixes due to the fact that my product was specified only to be the phone holder, and it had to be a fully digital model.

Step 8: Add Shadows and Lighting



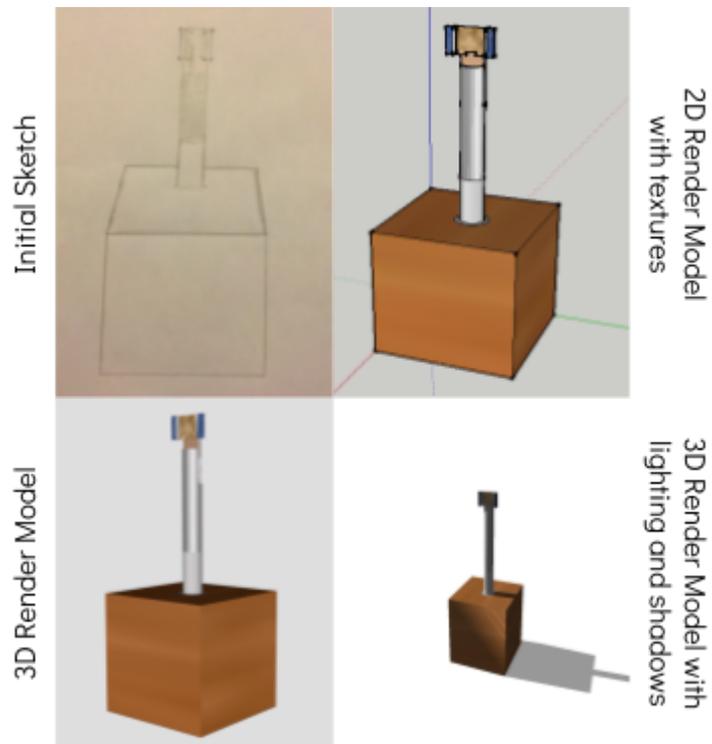
For this step, I used my 3D render that had been rendered with Adobe Photoshop, saved it as a separate file and reopened it to add the lighting and shadows in Adobe Photoshop.

Step 9: Refining

After I completed my three dimensional digital drawing of my product and its installation, I had to ensure that I checked it for any unusual looking parts (wrong colours rendered, transparency and positioning issues) due to computer mistakes or human errors (incompletely or excessively drawn, drawn from wrong perspective). I also had to ensure that it could perform each and every function as intended. I used a 3D product simulator to do so.

Step 10: Final Check

As a final confirmation to check that my product would conform to the laws of Physics and work as intended, I exported the file from Google Sketchup into Google Cardboard, a simple virtual reality application created for mobile phones. Following that, I had to export the 2D cartoon like product to a 3D rendered version. I then proceeded to add on the Computer Generated Imagery effects such as shadows and lighting so the product would look more realistic.



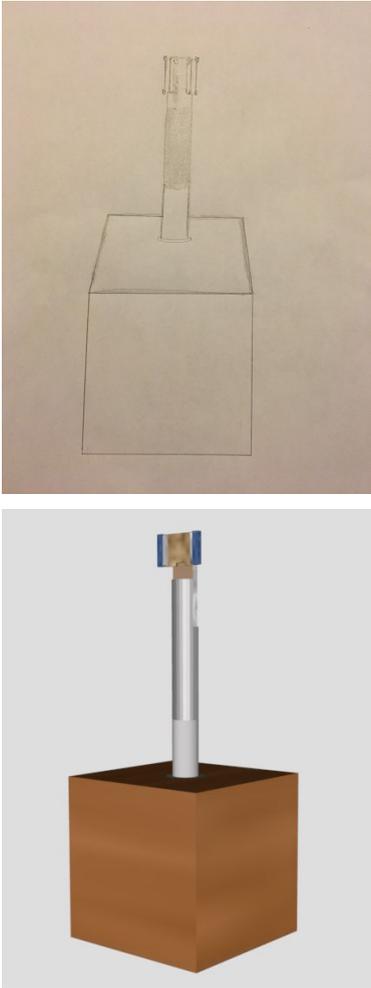
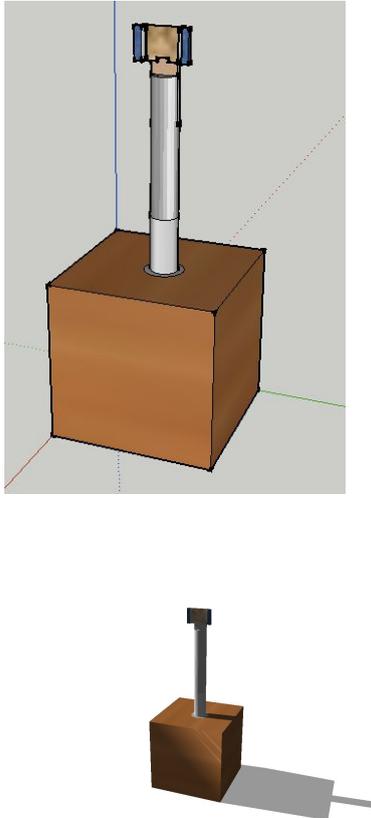
Peer and End-User Evaluation

For this step, I've published a survey for my peers and potential end users to fill in.

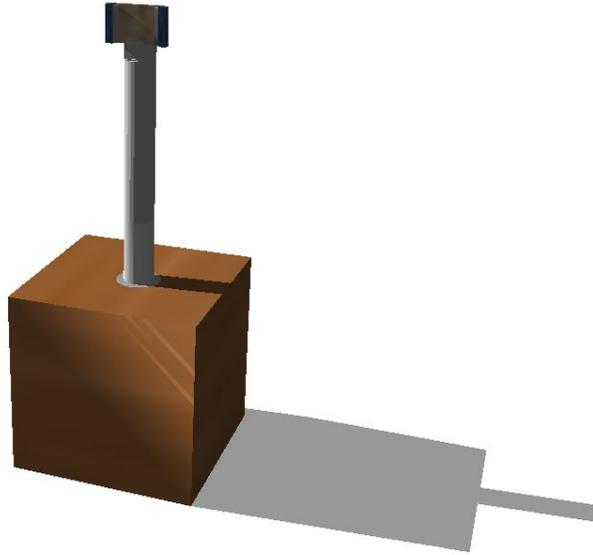
Submission

For this step, I've completed my product and have confirmed that this will be my submitted product.

3.3 Design Changes with Justification

Sketches	Product	Justification
		<p>From the sketch to the 2D product, I followed the design very precisely and there were no changes in the initial design. However, I changed the material of the base from the intended plastic base to a wooden base as wood would be more cost friendly and take less time to assemble. I also decided that the interior of the wood would be fitted with a metal frame for support. Before I rendered the final design, I however, added a ring around the tube that supports the bendable material that would be attached to the phone stand clamp as it the tube had to have a secure place around it. The installation of the product is simple, so it does not need a diagram. It is simply a bendable metal tube that is attached to a unmalleable tube which height can be adjusted with a clockwork gear system and attached to a turntable mechanism on the top of the device. The bendable tube is a is controlled by the user manually. The phone clamp is simply a mechanism to secure the phone onto the stand.</p>

3.4 Final Product



Criterion D - 4.0 Evaluating

No.	Task	Date of completion
4.1	Self-Evaluation	22/2/17
4.2	Evaluation Through Surveys	24/2/17
4.3	Evaluation Against Design Specification	3/3/17
4.4	Impact On Target Audience	4/3/17
4.5	Improvements	6/3/17

CRITERION D

4.1 Self-Evaluation

I think my product is fairly good as it has reached most of the design specifications.

However, there are improvements that can be made. These improvements to be made will be discussed in the improvements section.

4.2 Evaluation Through Surveys

i) Peer Evaluation Through Survey

I requested my peers to assess my product on a google sheet, as a way to get critiques, feedbacks, and comments. Some of my questions included whether my product matched my product's design specifications. A question was also asked on how aware people were on the dangers as well as risks of mobile phone usage. Through the feedback I have received from my friends, I now know what needs to be improved for my product. Furthermore, I was also able to judge my work and learn to accept criticism. Here are my findings:

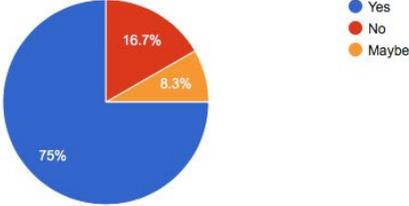
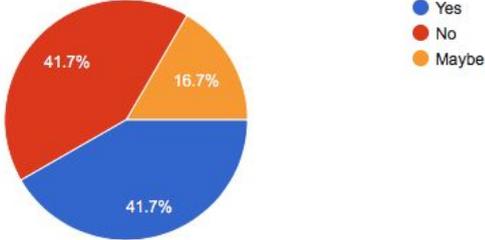
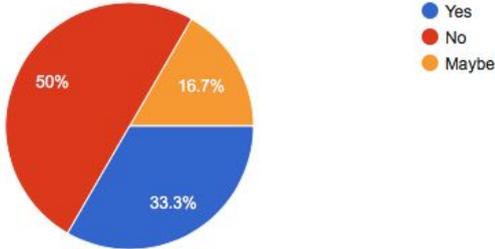
- Many people think that mobile phone usage has no risks
- They believe that my product is useful
- Many people believe that my phone stand fits
- The majority of respondents wouldn't buy my product because "there was no risk that came with using mobile phones"
- Most people had no comments on improvements to my product because "it was enough to satisfy the specified functions"

ii) End-User Evaluation Through Survey

From the previous survey done, I was able to learn how my potential end users felt about my product. Through this, I was able to identify my strengths and weaknesses, and was able to come up with improvements to make my product much better.

Plus	Minus	Improvements
<ul style="list-style-type: none"> ● Aesthetic ● Environmentally Friendly 	<ul style="list-style-type: none"> ● Too Expensive ● Not Modular Enough 	<ul style="list-style-type: none"> ● Cheaper Costs ● More Modular

iii) Survey Results

Question	Results								
Do you think this product is useful?	<p>Do you think this product is useful? (12 responses)</p>  <table border="1"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Yes</td> <td>75%</td> </tr> <tr> <td>No</td> <td>16.7%</td> </tr> <tr> <td>Maybe</td> <td>8.3%</td> </tr> </tbody> </table>	Response	Percentage	Yes	75%	No	16.7%	Maybe	8.3%
Response	Percentage								
Yes	75%								
No	16.7%								
Maybe	8.3%								
Does it fulfil the criteria of the solutions that it's supposed to solve?	<p>Does it fulfil the criteria of the solutions that it's supposed to solve? (12 responses)</p>  <table border="1"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Yes</td> <td>41.7%</td> </tr> <tr> <td>No</td> <td>41.7%</td> </tr> <tr> <td>Maybe</td> <td>16.7%</td> </tr> </tbody> </table>	Response	Percentage	Yes	41.7%	No	41.7%	Maybe	16.7%
Response	Percentage								
Yes	41.7%								
No	41.7%								
Maybe	16.7%								
Do you think phone usage causes injuries to ourselves?	<p>Do you think phone usage causes injuries to ourselves? (12 responses)</p>  <table border="1"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Yes</td> <td>33.3%</td> </tr> <tr> <td>No</td> <td>50%</td> </tr> <tr> <td>Maybe</td> <td>16.7%</td> </tr> </tbody> </table>	Response	Percentage	Yes	33.3%	No	50%	Maybe	16.7%
Response	Percentage								
Yes	33.3%								
No	50%								
Maybe	16.7%								

<p>Suggest some improvements.</p>	<p>Suggest some improvements. (11 responses)</p> <p>Nobody leans towards the table to see their phone, make it mobile, like the sink pipe or mic stand</p> <p>I do not think it fits my architecture of my house</p> <p>Suggest the phone automatically switches on when it is attached to stand or use the stand to project images from the phone so that one does not need to strain one's eyes looking at phone n images can be shared by many users.</p> <p>it's perfect</p> <p>idk</p> <p>You</p> <p>IDK</p> <p>there are no problems. why create a solution?</p> <p>Make it less bulky</p> <p>nothing</p> <p>x</p>
<p>Why would you use or not use this product?</p>	<p>Why would you use or not use this product? (11 responses)</p> <p>I do not use phones that often so it no use to me, but good for phone addicts</p> <p>Because it will stand out too much in my house</p> <p>Improvising product as above would bring better benefits</p> <p>i would, to curb the risks of mobile phone usage</p> <p>it looks cool</p> <p>I dont have phone</p> <p>Yea</p> <p>i wouldn't, there's no problem.</p> <p>No because too bulky</p> <p>i wouldn't theres no need</p> <p>i wouldn't, mobile phone usage has no risks</p>

Survey Results: Refer to Appendix 8

4.3 Evaluation Against Design Specification

Specifications		Design 1	Design 2	Design 3
Aesthetics	Is it modular?	X	✓	✓
	Is it portable	✓	X	✓
	Does it qualify to be a phone stand?	✓	✓	✓
Cost	Can the product be completed with as less cost as possible?	✓	✓	X
	Can the product be sold at a reasonable cost?	✓	✓	X
	Can the product be completed quickly?	✓	X	X
Target audience	Is the product suitable for the target audience?	✓	✓	✓
Environmental considerations	Does it bring any negative effects to the users environment?	✓	✓	X
Function	Does it affect the user's phone functions?	✓	X	X
	Will it satisfy the intended function?	X	X	✓
Model	Is the digital product presentation realistic?	-	-	✓
	Is it logical? Would it conform to the laws of physics?	-	-	✓
	Is the product annotated?	-	-	✓
Success criteria	What grade will it be given, according to the rubrics?	4	6	7

Since I had chosen Design 3 as my final design, It matched most of my design specifications, except the cost and time taken. The product is modular and portable as the stand itself is retractable straight into the base and it doesn't require a lot of space, hence can be fitted anywhere. Any product would be suitable for the target audience of such a wide age range. This product will not bring any negative effects to the environment as it is made of mostly eco friendly (recycled) wood, metal and there is a minimal use of plastic in the final product. It does not bring any negative effects to the users environment or their phone functions because the rubber paddings on the side of the clamp allow the phone to be used without damaging it by pressing the buttons of the device and the two sided clamp allows the phone's ports to be used. The phone can also be used in portrait or landscape mode. The product does satisfy the intended function of reducing the chances of one getting neck injuries, hand and neck muscle sprains or spinal cord and back injuries from using their mobile phones and it reduces eye strain because users are forced to sit down or stand up to use their phone and can't lie down. The digital product presentation is satisfactory and it does conform to the laws of physics and it is logical as tested in Google Cardboard and Google Virtual Reality. Although the product is annotated on paper, it still counts as annotation and therefore checks that specification as well. Although my product would be costly to build in real life due to the material choice and would take a long time to build as well which results in a higher costs, they are a few of the least important specifications.

Criteria	Comments
Was the product modular and portable?	It was modular and portable. The size was appropriate to be hand carried.
Does it quality to be a phone stand?	Yes, it does, despite its unconventional design.
Can the product be sold and produced at a low price?	No, it can't, because of the portability, the cost of being able to fit the mechanisms into it would be relatively high.
Can the product be completed in as little time as possible?	No, it can't, because of the construction method, as it is likely to be handmade. Unless assembled by machines, it would take a long time to assemble.
Does it bring any negative effects to the user's	No, the product has no negative effects to the users environment or the natural environment either due to the eco-friendly choice of materials.

environment and phone functions?	
How is the digital presentation of the product?	The product presentation was smooth, there were no errors found, and the render was a high quality render as well.
Will the product conform to the laws of physics and logic?	The product does conform to the laws of physics and logic, and works fine in the Google Cardboard Virtual Reality Software.
Overall grade:	7
Summary: Based on self-evaluation, I have achieved a grade of 7 for my product. I believe that I could achieve an 8 if I had made my product in a more elaborate manner, together with the internals being illustrated as it now could be able to be much more elaborate as opposed to a simple construction with no internals or mechanisms used shown.	

4.4 Impact on Target Audience

My product has met all the product criteria that I have set previously, ranging from aesthetics to environmental consideration. Based on self, peer and end-users evaluation, it is accurate to say that my product can achieve a grade of 7. My product will most definitely help curb the risks and health issues than an come with mobile phone usage should it ever be released.

4.5 Improvement

I think that there are still rooms for improvements in my product as firstly, I couldn't follow the design specifications of having as little time cost and money spent on production as well as well as low selling price. I could improve this by using for cost effective machine assembling strategies and more cost effective materials. In terms of the 3D rendered product model, if I could use more advanced software to render it, or added further layering and textures as professional animators would while creating a 3D animated movie or motion picture, the product model quality could have been improved a lot. However, this would increase the cost of the creation of the 3D model of the product, which I wished to keep at zero cost from the start.

Appendix & References

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Appendix

Appendix 1

Phone Screen Size

<http://appleinsider.com/articles/14/05/06/before-apples-iphone-was-too-small-it-was-too-monstrously-big>

<http://www.androidauthority.com/iphone-se-screen-size-681284/>

<http://pocketnow.com/2016/01/27/four-inch-iphone-make-sense>

Appendix 2

A Brief History of the Power Bank

<https://www.easyacc.com/media-center/a-brief-history-of-power-bank-what-has-it-replaced-and-what-has-failed-to-replace-it/>

Appendix 3

Product Case Study: Gravity iPhone Case

★☆☆☆☆ At your own risk..

By Ryan W. on April 17, 2016

Offer Type: iPhone 5/5s | Package Type: Standard Packaging | **Verified Purchase**

Product was cool at first, but shortly after I sealed it to a wall, it fell and shattered my new iPhone. Not worth it.

▶ Comment | 39 people found this helpful. Was this review helpful to you? Report abuse

★☆☆☆☆ Very bad , and I want my money back

By Ibraheem shammakhi on February 18, 2016

Offer Type: iPhone 6/6S | Package Type: Standard Packaging | **Verified Purchase**

The case is very bad , and this is not fair , it stick for 3-4 hours and then its normal case !!!

▶ Comment | 12 people found this helpful. Was this review helpful to you? Report abuse

★☆☆☆☆ I'm not sure what gravitational pull this is referring to ...

By bookwormgrrr! on August 21, 2015

Offer Type: iPhone 6/6s Plus (5.5-inch) | Package Type: Standard Packaging | **Verified Purchase**

I'm not sure what gravitational pull this is referring to, but certainly not on Earth. The first time I used this case, I stuck the phone to a flat vertical surface.....where it stayed for about 5 minutes before falling and cracking the screen. Since then, it doesn't stick to anything. It rubs against things and will resist (not prevent) sliding across the dashboard of my car, but that's the sole benefit. NOT worth the cost.

▶ 1 comment | 18 people found this helpful. Was this review helpful to you? Report abuse

★☆☆☆☆ good case for the 1st day only

By usooiii on February 11, 2016

Offer Type: iPhone 6/6s Plus (5.5-inch) | Package Type: Standard Packaging | **Verified Purchase**

in the 1st time it was very good, but after 2 days it's just a normal case.

<http://www.usatoday.com/story/tech/2015/07/09/sticky-iphone-case-not-to-sticky/29916529/>

Appendix 4**Task related to Global Context and Key Concept and Related Concept****i) Global Context**

Mobile phones are highly related to Scientific and Technical Innovation, as they are indeed products of human's scientific discoveries and technical innovation. Phones were here all around, it's just that they had to be innovated. The phone of the old days was also a phone. Today's modern smartphones are just an innovation of the old brick-shaped mobile phones. And the brick shaped mobile phones are an innovation of Alexander Graham Bell's landline phone. However, a phone is a communication device and there was the telegraph before that. And before the telegraph, there were other ancient communication methods. So basically, nothing is ever invented, it is just innovated. Scientific and Technical Innovation has enabled us to combine all the features of cameras, record players, notebooks, portable handheld gaming systems and more all into one device. It has also caused users to use the phone for a longer period of time now. The innovation of the smartphone has simplified life for us by combining many products into one, but it has also started to pose health risks on users as the usage time increases.

ii) Concepts

Development plays a big role in phones as are they are being developed non-stop. They are being developed to pack more battery life, be faster and smarter. However, phones are not really being developed with the end-user's experience taken into account. Instead, they are only developed to look good on the outside and in specifications, but not feel good or user friendly both on the inside and outside. The manufactures of major smartphones have constantly believed that how products look like is the most important feature of smartphones.

Appendix 5**SMART Goals**

Specific	The goal of my product is to improve the user experience of using phones and decrease the risks of getting injuries (such as back and neck injuries) from both the short term and long term usage of mobile phones in our daily lives. It will also decrease the strain that a user will get in his or her hands while using their phone.
Measurable	The goal will be considered met when the product is done well and when the surveys leave a positive remark on the product. The progress will be tracked by the results of the survey that will be sent out upon completion of the product design.
Achievable	My goal is achievable because some people have accomplished my type of goal in another aspect, so I believe that I can also accomplish the goal, despite it being a bit challenging, hence the goal being able to be reached.
Relevant	I believe that my goal is relevant as product purpose are a form global context where all the something 1 plays a very important role in the something 2. Raising awareness of an issue can realistically be achieved, as others have done it before, therefore I believe that I can also achieve it.
Time-Bound	<p>QUARTER 3</p> <p>Week 2 - Research on ergonomics</p> <p>Week 3 - Research on health and side effects of mobile phone use</p> <p>Week 4 - Research on existing solutions</p> <p>Week 5 - Research on ?</p> <p>Week 6 - Relate</p> <p>Week 7 - Request for brief help</p> <p>Week 8 -</p> <p>Week 9 - Submission date</p>

Appendix 6**Product Criteria**

Band	Specification
1-2	<ul style="list-style-type: none"> ● Does not serve planned purpose ● Affects the quality of usage of phone ● Absolutely no user friendliness ● Not portable ● Product is not well designed ● Installation of product inefficient ● Does not help the end user overcome most of the intended criteria set to overcome
3-4	<ul style="list-style-type: none"> ● Serves part of planned purpose ● Affects the quality of usage of phone ● Little user friendliness ● Vaguely portable ● Product is not very well designed ● Installation of product not well done ● Helps the end user overcome some intended criteria to overcome
5-6	<ul style="list-style-type: none"> ● Serves planned purpose ● Minimal effects on usage of phone ● User friendly ● Portable ● Product is well designed ● Installation well done ● Helps the user overcome intended criteria to overcome
7-8	<ul style="list-style-type: none"> ● Serves planned purpose well ● Usage of phone not affected ● Very user adaptable ● Modular and portable ● Product has excellent design ● Product has accurate installations ● Helps the user overcome all criteria intended to overcome

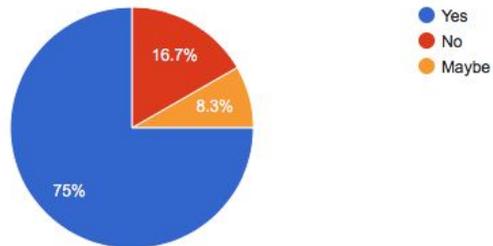
Appendix 7

MYP Design Cycle

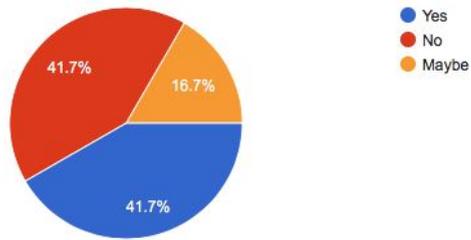


Appendix 8**Survey Results**

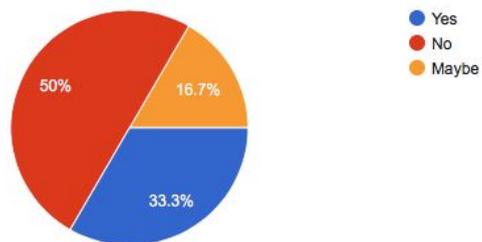
Do you think this product is useful? (12 responses)



Does it fulfil the criteria of the solutions that it's supposed to solve? (12 responses)



Do you think phone usage causes injuries to ourselves? (12 responses)



Suggest some improvements. (11 responses)

Nobody leans towards the table to see their phone, make it mobile, like the sink pipe or mic stand

I do not think it fits my architecture of my house

Suggest the phone automatically switches on when it is attached to stand or use the stand to project images from the phone so that one does not need to strain one's eyes looking at phone n images can be shared by many users.

it's perfect

idk

You

IDK

there are no problems. why create a solution?

Make it less bulky

nothing

x

Why would you use or not use this product? (11 responses)

I do not use phones that often so it no use to me, but good for phone addicts

Because it will stand out too much in my house

Improvising product as above would bring better benefits

i would, to curb the risks of mobile phone usage

it looks cool

I dont have phone

Yea

i wouldn't, there's no problem.

No because too bulky

i wouldn't theres no need

i wouldn't, mobile phone usage has no risks